91-01793 Technology transfer in a government research office (Ont.)

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Technology Transfer in a Government Research Office

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Documentation Page

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Abstract: This paper describes the organisational process of the R&D Branch, its interaction with client groups, and the technology transfer methods used to implement the results of research. The technology and programming methods used to manage the TT system are outlined. Emphasis is placed on involving the client with the research as an effective means of implementing research results. Methods of interaction and support of research at Ontario universities are detailed.

Production methods used to create presentation and published materials are described, with comments on the computer technology and software found to be most effective.

A custom software application for report distribution and inventory management is described, based on HyperCard information management software. Comments are made regarding proactive and reactive distribution and mailing list management.

The report concludes with a brief description of future possibilities, including a demonstration dial-up data base information system.

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1/ Introduction

The Ontario Ministry of Transportation is a $2 Billion a year agency responsible to the Provincial Government for all aspects of transportation, including construction and maintenance of the highways, licensing of drivers and vehicles, and support of the municipal roads system. Organisationally, the Ministry is established along functional lines in five "Programs", the largest of which is the Provincial Highways Program. A research and development office has been an integral part of the Provincial Highways Program for over 25 years, and has, over the years, conducted both in-house research and contract research on engineering topics such as structures, pavements, and materials — as well as topics such as traffic systems, decision engineering modelling, and human factors research. As well, through associations with other offices of the Ministry, joint research projects on transit, noise and vibration, and safety legislation have been conducted.

As with all research organisations, the question of report publication is recognised by the R&D Branch as being of great importance. Throughout the history of the Branch, reports have been considered to be our "product" and considerable effort has been devoted to producing reports that are accurate, pleasing in appearance, and easy to read. This has been done by dedicating editorial and graphics staff to the publication process. However, the process has proved to be very expensive and in recent years we have searched for ways to reduce costs, mainly through the use of microcomputer technology and by establishing publication standards.

Also, we have come to recognise that technology transfer is much more than just distributing reports. Much of our recent work has been directed at identifying the audience for implementation of our research results and in developing technology transfer techniques to get results to them. These techniques include :

1) Publishing and distributing reports, society papers, and magazine articles describing the results of research.

2) Publishing manuals and codes in co-operation with operational offices, in order to implement the research results.

3) Producing and distributing slide presentations.

4) Maintaining an extensive mailing lists of client groups and those offices likely to use research results to write specifications and standards.

5) Maintaining an inventory and a catalogue of reports.

6) Providing copies of technical literature.

7) Publishing a quarterly newsletter summarizing recent research activities.

8) Holding training sessions, workshops and technical conferences.

This paper will describe the organisational process of the R&D Branch, its interaction with client groups, and the technology transfer methods used to implement the results of research. In particular, the authors will include a description of the technology and programming methods used to manage the TT system.

2/ Brief Overview

The Research and Development Branch has a staff of 50 persons, most of whom are engineers and scientists devoted to research in support of the Provincial Highways Program of the Ministry. Many of the staff in the Branch have been involved in research for most of their careers; in some cases with the same ministry. Thus, they have developed specialist knowledge in many areas, and there is a great deal of continuity over the years.

Funding for the Branch is allocated on a annual basis to support both salary and operating expenses. Contrary to practice elsewhere, no fee-for-service arrangement has ever been used. However, while it's true the Branch is fully funded, and a certain amount of fundamental research is initiated by the Branch, the understanding is that research should be conducted with operational objectives in mind and in most cases an internal Ministry client is required before a project can be undertaken.

Clients are identified through an annual Ministry-wide request for "Research Needs", which goes out to previous and potential clients within the Ministry. Requests for a statement of Research Needs are also sent to key Ontario universities. The response, which may amount to more than 100 research proposals, is subjected to a case-by-case review and priority setting process, and the chosen projects are passed to a senior program committee for final approval. A "Need" thus approved, is identified as a "Branch Project" which can be conducted by internal R&D staff, or sent out to consultants who are asked to submit proposals for the research to be conducted outside the Ministry.

A certain amount of the research funding is assigned each year to projects that can be carried out by universities. One side benefit of which is in stimulating interest in a career in transportation by assisting graduate students in the completion of an advanced degree. In such cases, a formal project report is issued by the Ministry in our own publication series, and usually a separate report will be issued by the university to satisfy the requirements of the degree program.

In those cases where unsolicited proposals are submitted, they are included in the priority setting process and, providing they meet the needs of the Ministry, such projects can be accepted for inclusion in the Work Plan for the upcoming year. While they are not a large part of the R&D program, the approval of unsolicited proposals is particularly useful for universities and we consider it part of our mandate to assist, through research, the education of engineers in Ontario. This is an indirect, though very positive, form of technology transfer. Accepted proposals are identified on the Annual Work Plan and administered through formal contract agreements.

2.1/ Interaction with the Clients

Interactive dialogue between potential or actual clients and the Branch is typical of our approach to research, and an essential element of technology transfer. Typically, clients form part of a project team and therefore "get their hands dirty" as the research progresses. Even when they prefer a more arm's-length participation, they are kept informed through presentations, and membership on steering committees directing the projects. Thus, publication of the final report is often a formality as far as technology transfer to the client is concerned, though the report is still an important vehicle for informing a wider technical audience.

2.2/ Technology Transfer in the R&D Branch

The R&D Branch is required to transfer the results of its work to those who will implement the conclusions and recommendations into meaningful operational standards, specification, codes and practices. The results of research include:

1) *Completed work showing successful results.*
   All possible TT techniques may be used to effect the implementation.

2) *Completed work showing unsuccessful results.*
   It is important this information be accessible to other researchers to assist their efforts and avoid future duplication.

3) *Results of work still underway.*
   Interim results are not widely circulated, but they are often important for decision-making, especially where there are implications for safety.

To carry out this mandate, and to come to grips with the principles of technology transfer, it's important to recognise the problems of research in a government setting. Research, by its nature, exists in a rapidly changing environment; it is subject to unexpected technology impacts; and it often uses complex terminology and scientific notation. In addition, the requirements of the Government often cause dramatic shifts in priority. Recently, for example, there have been a number of disastrous used-tire fires and, naturally, this has intensified the need for investigations into the use of tires in recycled pavement. For all of these reasons reports, presentations, and research notes are difficult to produce, and they are subject to last-minute corrections and tight deadlines.

2.3/ Identification of Target Audience

Clearly, one of the underlying principles of technology transfer is that the information must get to the right people, at the right time. In a government research setting the "right people" are mainly those who effect operational functions and corporate policy. But there is also need to transfer information to the external communities in order to meet government scientific objectives and to support commercial enterprise in the province. For a research group in particular the most usual audiences for technology transfer are:

- *Technical Staff*

  Within the Ministry of Transportation researchers are in close contact with the operational offices linked to their specialties. For example, a timber bridge research specialist will have the Structural Office as one of his/her principal clients and will be aware of individuals in that office who need to be kept aware of the results of his/her research. These clients will eventually be responsible for writing the specifications that implement the research results. Our specialist will also be in close contact with field staff who are impacted by the research work and keep them up-to-date on likely modifications to their operational procedures.

  At the same time, a researcher is aware of external authorities such as professional and technical associations, and standards authorities that will use his/her work. In this way, a network of professional contacts is built up and it is to these people that a major technology transfer effort must be directed.

- *Senior Government Staff*

  Senior Ministry staff are also an essential audience for the researcher — indeed, for us, they are often the audience that counts most. It is to Senior Management that the researcher must present summarized information to enable them to make policy decisions and, where necessary, propose changes in legislation.

- *Contractors, Manufacturers and Consultants*

  While transportation-related specifications and standards are written and administered by governments, the contracting/manufacturing/consultant industries are responsible for the product itself. They are also consulted during the preparation of codes standards and specs. These groups must be kept aware of trends in research that could affect future business decisions.

- *Academia*

  As noted earlier, the R&D Branch considers interaction with universities and colleges one of its objectives. Information exchange is very much a two-way street, given the large amount of work contracted out to the universities. As a consequence, joint papers and publications are a common occurrence.

- *General Public*

  And finally, there is an audience of interested observers and the general public who should be kept informed of scientific innovations and discoveries.

3/ Technology Transfer Methods

3.1/ Research Reports

By far the most usual method of transferring the results of research has been through the distribution of reports. Such reports are written at a technical level appropriate to the research topic being discussed and are not generally intended for the lay person. These reports are issued free of charge and have taken a number of different forms, depending on the planned distribution. For instance, a report of major importance, with a large distribution list and containing results likely to impact both the Ministry and external agencies, is published in our "flagship" Research Report (RR) series. This series has a contemporary graphic design, is typeset, printed in two colours on quality paper, and has a wrap cover. Internal reports, and others not likely to have a large distribution, are printed from typewritten or computer-printed originals and Cerlox bound. In all cases, editing assistance is available to the author and the mechanics of producing the report are handled entirely by the technology transfer office.

3.2/ Society Papers

Publishing papers in Society Journals is a very effective way of transferring information to the scientific community. Papers tend to be short summaries of the research report and, again, they are intended for an informed audience. The format of papers is usually rigidly defined by the publishing society and this sometimes presents problems in achieving the specified format. Also, because of the fixed deadlines such papers have there is always a scheduling problem, particularly as authors often begin writing just a few days before deadline.

3.3/ Newsletter

The R&D Branch issues a newsletter four times a year which highlights research in progress, and gives notice of upcoming conferences, and a list of recently issued reports. The newsletter, entitled *R&D Reports*, serves a very useful function in keeping both technical and non technical audiences informed of research, and it helps to raise the level of internal support by identifying possible future research topics. The newsletter is considered to be a very effective way of:

- getting our research information to Ministry operational staff who simply don't have time to read long reports;
- making trade papers aware of recent advances in our research;
- informing a wide audience of the availability of research reports.

There are however, a number of problems associated with a newsletter:

- It is time-consuming to produce and places constant pressure on limited staff resources.

- The distribution list is growing (currently about 900 subscribers), therefore the cost of printing and mailing can become a major problem. However, some of the cost is self-imposed as we feel the greater impact of colour illustrations justifies the higher cost.

- Researchers often find it difficult to sacrifice technical detail and omit qualifying statements in order to make an interesting article.

The newsletter is produced internally, using Macintosh computers (with large screens) and desktop publishing software. Our software of choice is *Ready,Set,Go! 4.5* because we find it fast, reliable, and precise.

3.4/ Manuals and Codes

Manuals and codes are the ultimate method of instructing field staff on the operational procedures resulting from research and, typically, they are produced in co-operation with the operational office. They are generally large, complex documents that must be precise in every detail and printed on durable, good quality paper. In other words, they are very expensive to produce and we have concentrated our efforts in recent years to reduce the production costs of manuals and codes through the use of technology and standardised formats.

3.5/ Personal Contact with Audience

In order to avoid exile of our reports to the filing cabinet or waste basket, we attempt to emphasize the importance of the TT material by writing covering letters to the target audience to accompany the reports, papers, codes, etc. These letters are addressed to individuals and briefly describe the significance of the research and the implementation procedures expected in the future.

3.6/ Presentation Material

Because we recognise that audiences remember more of what they *see* than what they *hear*, we make heavy use of visual aids to support verbal presentations by technical staff.

Our favoured medium is 35 mm slides. They have been a standard visual presentation method for many years and they are well-suited in "fact-to-face" situations. Thus they are one of the most effective methods of technology transfer open to the researcher. Today, we use a colour Macintosh to create full-colour artwork and either print the art on a QMS ColorScript printer, or send the files to a service that makes slides from computer art. This replaces our previous time-consuming methods of adding colour optically to black and white artwork or manually to black and white slides

In recent years, much use has been made of video tapes to assist the process of technology transfer both at a technical level and for general interest presentations. Compact, easily-operated video equipment has become readily available, and with the introduction of inexpensive video playback equipment, training sessions can be conducted in a much more dramatic way than previously.

Both slides and videos can be reproduced very cheaply and when used in conjunction with taped messages, they make possible training sessions by staff other than the technical specialists responsible for the original research.

3.7/ Conferences

By issuing research reports, newsletters, and copies of society papers the R&D Branch is able to disseminate information to a wide audience in a efficient and timely manner. But one of the most effective methods of technology transfer is personal presentation to training sessions and conferences. Consequently, research staff consider it a normal part of their function to take part in conferences, either by delivering papers, or by assisting in organising the event.

There is tremendous technology transfer value in the discussions following presentation of a paper, and conference audiences often feature a mix of people difficult to assemble otherwise. Interaction at conferences between individuals with national and international organisations and specialist societies creates informal networks that are effective in keeping researchers up to date and in touch with events elsewhere.

However, the disadvantages of conferences include the cost to the Ministry of both staff time and travel expenses. This especially applies to the efforts by staff involved in organisation of the conference.

3.8/ Training Sessions

Conferences usually involve an audience of technical peers where the objective is dissemination of information and interchange of ideas. Training sessions, on the other hand, are to instruct staff in the operational procedures that result from research. While not specifically the mandate of the R&D Branch, some training sessions are conducted — particularly where highly technical topics are concerned. The researcher will usually conduct the training sessions in the area of his/her own specialty — thus, becoming a champion for the implementation of the research.

4/ Production Techniques

As noted earlier, publications relating to technology transfer in the R&D Branch are the responsibility of an office staffed by editors, commercial artists and student assistants. In the past, production techniques have included typed manuscripts, hand drafted diagrams and external typesetting. However, our present techniques are based on the Macintosh computer.

Typically, a report is written on a computer and passed to the publications group for editing and preparation to Ministry standards. We ask authors for "camera-ready" artwork, and give out detailed instructions of what we require. However, our authors often fail to meet our specifications and we therefore request both a hard copy and a disc copy of the report.

As a result, we have had to acquire some facility in "capturing" documents from various software and hardware environments and converting the data for use with *Microsoft Word 4.0a*, which is our normal software for producing reports. Most of the mainline word processors make environment transfer easy because they offer a variety of options in file format when the document is saved. Also, products such as *WordPerfect*, *Microsoft Word*, *WordStar*, etc. can be opened directly by our Mac software, or they can be easily converted with utility programs. To simplify transfers, our Macs are equipped with disc drives that can read and write a variety of MS-DOS disc types. File transfers can also be achieved over a local area network comprising a mix of computer types. One recent report was written on a Commodore 64 and the text had to be communicated via modem onto our Mac. The communication process converted the file format to generic ASCII and we were thus able to read it.

We do have difficulty, however, when authors use more esoteric word processors such as T_EX or *Lotus Manuscript*. These products are used because of their ability to produce scientific notation. The equations, however, never survive the translation and must be reconstructed. *Microsoft Word* has a built-in equation-generating command language; however, we find we can do equations faster, easier, and more æsthetically using "point-and-shoot" Desk Accessories such as *MacΣqn* or *Expressionist*. Of these two, *MacΣqn* is easier to use, but *Expressionist* is more reliable, and can be readily corrected.

The output quality of 300 dots per inch laser printers is adequate for most publication purposes; however, for large volume brochures and high profile reports, we usually take the extra step of having our files processed through a PostScript imagesetter capable of greater resolution (1200 or 2400 dpi).

Drawings, as well as text, are done on the computer and the two are integrated during the format and editing process. Our drawing software of preference is *Illustrator 88* because of the elegant and precise images we can create with it, though we also use *MacDraw II*. Having an entire report on disc simplifies subsequent reprints and revisions, and saves a great deal of space over conventional storage of paper-based mechanicals. We have experimented with using a scanner and image processing software for reproduction of photographs but, for now, we conclude it is more trouble than it's worth, except in special cases where the photo image needs enhancing.

5/ Report Distribution

Over the years, the R&D Branch and it's predecessors have published over 1,000 technical reports. We endeavour to maintain all of these in stock as we continue to get requests for old reports. People find out about our reports in the following ways:

- References in the technical literature;
- Word-of-mouth references from colleagues within and without the Branch;
- Mail-outs by the Branch:
  - to persons and organizations we have identified,
  - to organizations with whom we have an exchange agreement,
  - to key libraries in universities and relevant government organizations, nationally and internationally;
- Computer searches — through RTAC, our reports are listed in HRIS;
- The Ontario Government Monthly Checklist of publications;
- Through having requested reports previously and/or receiving one of our catalogues;
- Through subscribing to our Branch newsletter ***R&D Reports*** , which lists all new reports and features articles on current research.

In the last 12 months, about 2500 documents, representing 16 separate titles, were mailed out to targeted recipients. This is in addition to reports requested by mail, by telephone and, recently, by fax. We responded to 946 individual requests in the past 12 months, distributing a total of 5721 reports. Typically, the number of reports per request is 2-4.

Although a "deterrent fee" has been considered, the Branch maintains a policy of not charging for publications, on the grounds that research done at public expense ought to be publicly available. Occasionally, an exception is made when a publication is unusually expensive. In this case, the report is sold at a token cost recovery fee through the Ontario Government Bookstore. The Bookstore also has the option to request quantities of our reports which they then put on sale, even though the report may be obtained free of charge from ourselves.

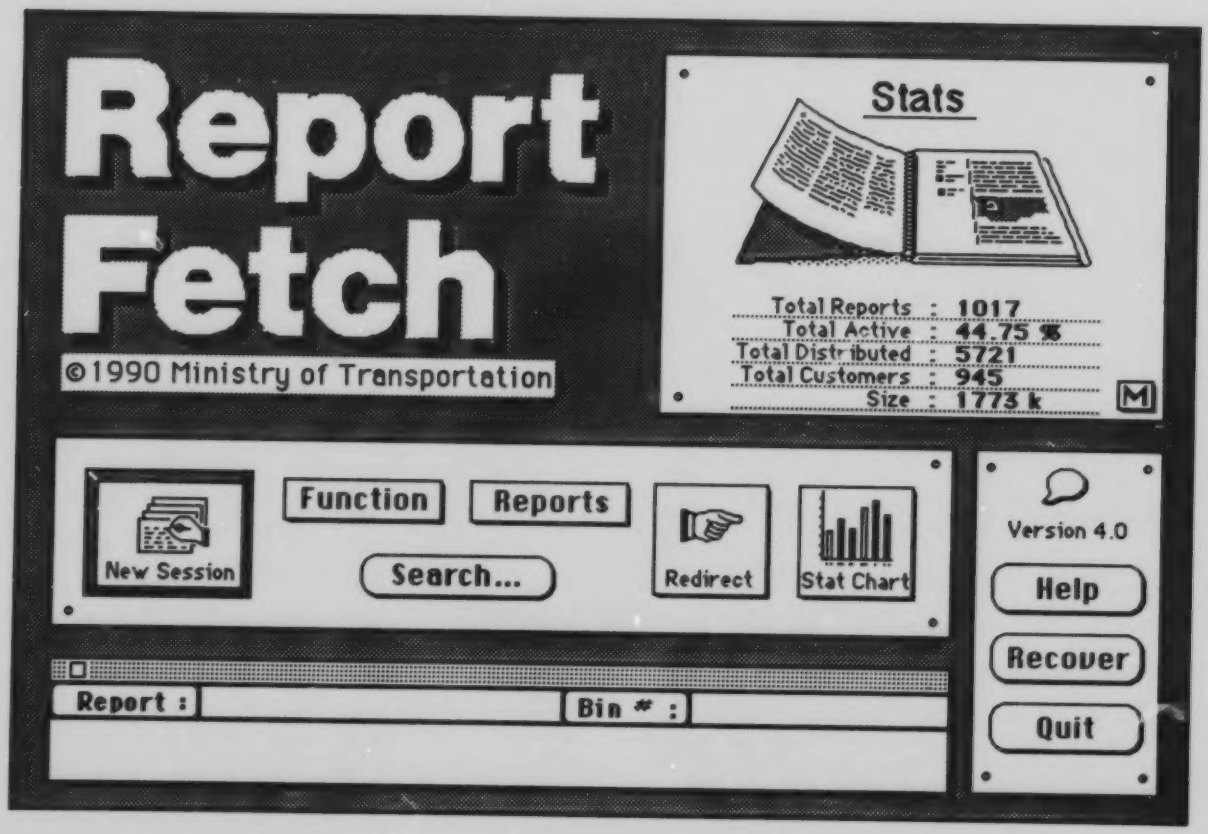
Regarding mailing list management, we at one time envisioned an elaborate checklist of different categories (universities, professional associations, peer groups, etc.) and subject areas for the author to consider. This generic approach simply did not work — the resulting lists were far too long and required a lot of paring down. Now we treat each report mailing list on an individual basis. Typically, a previous mailing list from a similar subject area is edited by both the author and the TT office. By the time the report is ready for printing, we have a

carefully-considered mailing list and an accurate assessment of the quantity needed. In summary, our experience is that maintaining a good mailing list is more of an art than a science. It is subjective by nature and necessity.

Responding to a large number of requests for a large catalogue of titles has traditionally been a time-consuming, frustrating process, normally handled by student assistants. In an attempt to gain better control of inventory, in late 1988 we commissioned a consultant to write a custom software application for us using Apple Computer's innovative *HyperCard* information manager.

The resulting system is called *Report Fetch*, and although enhancement and further development continue, the software was operational within three months. All criteria were met, and the distribution task which used to consume about 60% of two students' available hours, now consumes less than 25% of their time.

The following figure shows the main screen of the *Report Fetch* system.



Report Fetch can search for a report by title, author, or publishing office. It also searches for repeat customers to save typing and avoid multiple entries. It builds customer profiles and keeps statistics of all activities.

6/ Technology Transfer and the Future in the R&D Branch

a) Network Information Exchange

Many other offices within the Ministry of Transportation publish reports and maintain separate distribution processes. Thus, it is a problem to know who has published what, and when. Ideally, if the other offices use Macintoshes, and *Report Fetch* to manage their distribution, information about new titles can be exchanged over a network Thus, when a request is made to the wrong office for a report, *Report Fetch* can automatically redirect the request through the network.

b) Floppy Cat

Catalogues are bulky and expensive. Also, it's sometimes difficult to find what you want within a multitude of report series, and over a period of years. *Report Fetch* is therefore capable of creating a catalogue on a floppy disc which we term *Floppy Cat*. This is a disc-based catalogue containing abstracts for each report (which the printed catalogue does not in the interests of economy) which can be accessed by keyword search. Having found the required titles, *Floppy Cat* will compile the requests into a note to the R&D Branch Technical Publications Group, and print it out, complete with mailing labels or E-mail file. At the moment, *Floppy Cat* is still alpha-ware, but it runs under *HyperCard* on a Mac or *Plus* on a PC.

c) Technology Information Exchange Service (TIES)

In spite of the many predictions of it's imminent ascendency, the "paperless office" still does not exist. Yet, almost every office is now equipped with microcomputers. Recognizing this trend, and recognizing that any catalogue printed on paper will be obsolete almost before the ink is dry, *Report Fetch* has been designed to export the information it contains in a form suitable for placing in a dial-up database. The database is called TIES (Technology Information Exchange Service) and it resides on a trans-Canada data network. Thus, anyone with a computer and modem can make a local telephone call, sign onto the TIES system, and go hunting for reports based on keyword search and Boolean logic. The service is now in place as a demonstration project. The Ministry is custodian of much more information that would be of interest to a variety of specialized audiences and could be posted on TIES if it were decided to do so.

Though it must be admitted that response to such electronic information media in Canada has been less than enthusiastic, we are convinced that this is the wave of the future. It's just so much more efficient, and so much more powerful an information-gathering and transmitting tool, that it must succeed. Ultimately, one can envision entire reports being posted on TIES and those who want them could simply download them and print them in their own office.

7/ In Conclusion

Over the past few years the R&D Branch of MTO has become more aware of the importance of Technology Transfer and the need to exploit the various TT techniques to both inform our target audience and to reduce production costs. We will continue to place a high priority on research reports and issue them as required to both our clients and the scientific community. We will also expand our efforts to inform our audience through newsletters, papers, presentations and conferences. However, as noted, we are making extensive use of both computer technology and a dial-up database to create efficient production facilities and a more easily accessible information network. Our goal is a complete acceptance of such technology by both our clients and target audience. We are a long way from achieving that goal, both in terms of computer-familiarity on the part of our clients, and in terms of the technology required to do this economically. But perhaps the future of Technology Transfer requires that we do more to transfer awareness of the technology to the research community.